



**US Army Corps
of Engineers.**
Construction Engineering
Research Laboratory

Fact Sheet

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BIOFILTER TECHNOLOGY TO TREAT DOD VOLATILE ORGANIC COMPOUNDS IN AIR EMISSIONS

The Problem

Army ammunition plants, depots, arsenals, and troop installations often release volatile organic compounds (VOCs) in air emissions. In addition, some of these waste air streams contain unique substances such as explosives. Current technologies for VOC destruction are expensive when VOC concentration is low and air volume is large. A Tri-Service environmental quality users' requirement identifies VOC control as a top research and development (R&D) priority for Department of Defense (DOD) installations. There is a need to develop an enabling technology to treat DOD installations' VOC-containing gas streams.

The Technology

The U.S. Army Construction Engineering Research Laboratory (CERL) is investigating biofilter technology to remove VOCs from air emissions. Biofilters have been used for many years in Europe, mainly for odor control. Since the Clean Air Act Amendments (CAAA) of 1990 mandated regulation of 189 hazardous air pollutants (HAP), the biofilter recently has been revived as a biological treatment method for VOC-containing air streams in the United States.

A biofilter is a bioreactor system in which microorganisms are attached to a solid support medium or are suspended in the bioreactor (in the case of a bioscrubber). Contaminated air passes through the filter where the microorganisms consume the organic carbon to produce CO₂, water, and biomass. The four classes of biofilters, classified by the relationship of the biofilms to the water are: (1) bioscrubber, (2) bio-trickling filter, (3) natural media biofilter, and (4) synthetic media biofilter.

A bioscrubber usually consists of a scrubber and a bioreactor. A bio-trickling filter consists of columns filled with packing, on the surface of which a biofilm develops. The packing can be activated carbon, glass or ceramic beads, stoneware rings, and other materials. Nutrient-rich water trickles down from the upper side of the column. Contaminated gas is supplied either co-current or countercurrent to the water direction. In biofilters, the gas stream is humidified before contact with the biofilm. Natural media can include soil, peat, compost, or bark. Engineered medium biofilters are an attempt to provide the advantages of natural media with the liquid phase and biomass control available in bio-trickling filter.

Benefits/Savings

Benefits will vary case by case. In comparison with other competing technologies (carbon adsorption, condensation, incineration, ultraviolet, or chemical scrubbers), biofilter technology can be more economical. The advantages of biofilter are that they: (1) help produce nonhazardous final

products, (2) have low initial/operation and maintenance costs, and (3) represent a reliable technology for environmental compliance.

Status

CERL has successfully demonstrated the technical reliability of biofilter technology at Lake City Army Ammunition Plant (LCAAP) to treat ethyl acetate, a VOC generated from a bullet tip coating operation. In 1996, LCAAP chose to operate the demonstration system as a permanent facility.

Although biofilters have been used for long time for odor removal, biofilter treatment of VOCs and toxic gas stream is relatively new. In 1995, National Defense Center for Environmental Excellence reported a marginal success in treating paint booth gas stream using compost bed biofilter. Currently, a few package biofilter systems are available on the market. Most of the existing systems use natural media in specially designed containers. In contrast, the CERL system uses an engineered synthetic media, with a nutrient impregnated in it. Most studies involving this technology have been done on the treatability of specific gas streams, with a limited number done on operational conditions. CERL is extensively studying the operational conditions affecting the performance of bio-trickling filters and bioscrubbers. Nutrient requirements, the effects of water content in the reactor, nitrate effects, fluidization in the bioscrubber, and kinetic models have been developed. CERL is also working on the new method to treat VOC containing nitroglycerin using a bioscrubber, and is now developing improved biofilters and biofilter design data.

More information is available in Draft CERL Technical Report: *Biofiltration of Solvent Vapors from Munitions Manufacturing Operations* (1999).

Point of Contact

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